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Edward A. Bouchet Award Lecture: Saturation of the cross-polar cap potential[1]

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As the solar wind flows past the ionosphere, momentum and energy is transferred to the magnetospheric and ionospheric plasma, causing it to circulate. The circulation means that in the Earth's frame of reference there is a potential drop across the ionosphere, which is generally referred to as the Cross-Polar Cap Potential (CPCP). The potential drop is typically proportional to the Interplanetary Magnetic Field (IMF), since merging between the IMF and the geomagnetic field is the major mechanism by which mechanical stress is transmitted to the plasma in the magnetosphere/ionosphere system. However, for very large values of the IMF, the CPCP becomes insensitive to the magnitude of the IMF. This phenomenon is referred to as polar cap potential saturation. We will demonstrate that the saturation phenomenon is a direct consequence of a change in the force balance that determines the flow of the solar wind plasma into the magnetic merging region where the IMF merges with the geomagnetic field. When the IMF is small, the major force on the flow is the plasma pressure gradient. So as the IMF magnitude increases the flow is unaffected. However, when the IMF is large enough, the JxB force becomes the major force on the flow. Under such conditions, increasing the IMF magnitude increases the florae diverting the flow away from the merging region, thus limiting the transfer of momentum and energy from the solar wind to the magnetosphere.

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